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SAN FRANCISCO MAIN LIBRARY: A HEALTHY BUILDING

Anthony Bernheim, AIA.
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Architects

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San Francisco, California, USA

ABSTRACT

The design of the new San Francisco Main Library as a healthy building was a high priority for the City of San Francisco, the San Francisco Public Library and the Architects. The goal was to provide a safe and healthy environment for the library patrons and staff. The methods used to design a healthy building included developing a committed team, establishing Indoor Air Quality (IAQ) priorities, developing a process to select and implement strategies to ensure a healthy environment. The results include numerous IAQ strategies ranging from modifications to the heating ventilating and air conditioning (HVAC) system to careful selection of special materials. The IAQ strategies account for only 1.1% of the construction cost and in the long term appear to be cost effective. The purpose of this paper is to document the IAQ design process and results for use by others on future projects, and to indicate the cost effectiveness of IAQ design.

INTRODUCTION

The new San Francisco Main Library was designed by the architectural team of Pei Cobb Freed & Partners and Simon Martin-Vegue Winkelstein Moris, associated architects. The project, located in San Francisco's Civic Center (illustration 1) is presently under construction and is scheduled to be completed early in 1996.

The library was designed to house a complex program with numerous services including: Lower level (Basement)– Auditorium/Meeting Room Complex, Gallery; Upper Main Floor– Entry, Blind Services, Children's Library, Project Read, Friends of The Library Book Store; Main Floor– Entry, Deaf Services, Browsing Collection, First Stop Reference, Technical Services; Second, Third, and Fourth Floors– Open Book Collection, Service Desks, Reader Areas, Special Collections, Staff Work Rooms; Fifth Floor– Rare Book Room, Gallery, Roof Garden, Administration.

The healthy building concept was advocated by the key members of the project team, namely the project sponsor (City of San Francisco), the future tenants (the San Francisco Public Library), and the Architects.

The City was supportive of using IAQ design strategies provided the design and specification modifications occurred within the project budget.

The Librarians were concerned about the IAQ because they work in the Library more than forty hours per week. Early in the Schematic Design Phase, they heard that the proposed design called for fixed (non-operable) windows and large areas of carpet. They were worried that there would be limited amounts of "fresh" air; the carpets and adhesives would off-gas and pollute the already limited fresh air; the homeless population would "live" in the building and would further contribute to the indoor air pollution, and the City would reduce the building maintenance budget (to accommodate their on-going fiscal crisis) below reasonable levels resulting in the partial operation or the complete shutdown of the Heating, Ventilating, and Air Conditioning (HVAC) system. They predicted that the new Library would suffer from Sick Building Syndrome, and the library staff would contract short and long term illnesses. The Architect's goal was to design a superior public library, that is on budget, conforms to California's Title 24 Energy Conservation requirements and also provides a healthy environment for the library staff and patrons. We are aware that indoor building ecology problems (building related illnesses and Sick Building Syndrome) can result from poor design.[1,2] This paper documents and presents as a case study the strategies developed and used by the architects to design a healthy building for the New San Francisco Main Library.

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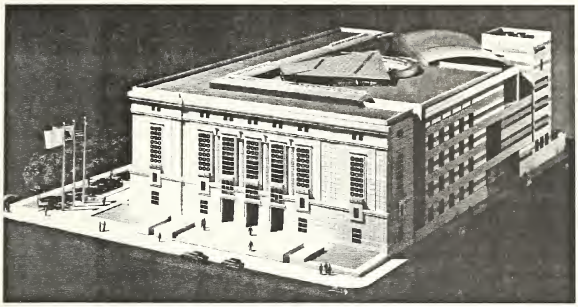

Illustration1. Model of the New San Francisco Main Library - 7 stories, 35,952 sq. m. (387,000 sq. ft.)

METHODS

1. **TEAM DEVELOPMENT.** First strategy was to assemble a team who would promote the healthy building concept. A series of meetings were held with the Architects, and the public, and the City Library staff to discuss IAQ issues and concerns. The library staff formed a Health Committee which expressed their concerns about the IAQ to the Library Commission and to the City. Nine months into the project development the City ultimately agreed on the importance and value of a healthy library and an IAQ specialist was invited to become a part of the team.

   The key players were now in line to assist in the process of a healthy library design and they included the City Architect, the Library's Chief of Facilities Development and staff , the Library Commissioners, the Architects, the Interior Designers, the Mechanical/Electrical/Plumbing (MEP) Engineers, the Acoustical Consultants, the specifical writer and the IAQ consultant.

2. **ESTABLISH PRIORITIES.** The IAQ consultant assisted the Architect and the Library in establishing priorities for achieving a healthy building. We developed a list of potential bacterial ponds, materials with high Volatile Organic Compound (VOC) emissions, and HVAC system related problems. This list was then prioritized , starting with the systems and materials that needed the most modifications, as follows: the HVAC system, particle board, carpet, adhesives, paints, furniture, and copy machines.

3. **DEVELOP PROCESS.**
   a. HVAC Systems: The M.E.P. Engineers, the IAQ Consultant, and the Architects isolated the major areas of concern that would affect the IAQ and developed response strategies for review and discussion with other appropriate specialists (e.g; the Acoustical Consultant).

   b. Materials and Products: The Architects arranged meetings (and telephone conference calls) with representatives from the materials, products, and furniture manufactures. We expressed our concern for the IAQ and requested information on their products such as Materials Safety Data Sheets (MSDS) and the chemical composition. As a follow-up, we sent letters to a designated specialist in each company requesting test data regarding off gassing of VOC's. We assured the companies that proprietary information would be kept confidential.

      We reviewed the MSDS's and other product data with the IAQ Consultant, and developed three product categories: acceptable, acceptable with modification, and unacceptable. We then focused our attention on working with some manufacturers to modify their products to reduce potentially harmful VOC emissions.

c. Cost Analysis: A cost analysis was prepared for the IAQ design strategies and was presented to the City and the Library for their evaluation.

d. Public Presentations: A series of public presentations were made to the Library staff, the disabled access community, the Library Commission and other special interest groups to explain how the Architects planned to address the IAQ issues.

4. **IMPLEMENT STRATEGIES.** The Architects worked with the M.E.P. Engineers, the Interior designers, the Acoustical Consultant, and the Specification Writer to implement and document these proposals. Some of the strategies were new to the City and required the assistance of the City Attorney to prepare legal specification language with contract penalties to ensure contractor performance during the construction.

RESULTS

1. HVAC SYSTEMS STRATEGIES (Diagram 1):

The careful design, construction operation and maintenance of the HVAC systems is one of the major components required to ensure a healthy building. The strategies listed below have been incorporated into the new library to limit bacteria growth in the HVAC system, to limit the spread of bacteria and VOC's through the building, and to provide more than adequate amounts of outside air to the inside of the building:

a. The HVAC systems outdoor air intakes are located on the roof at two corners of the building to reduce the intake of ground level air pollution (ie., exhaust from traffic).

b. Stainless steel strip bird guard will be installed over the horizontal rooftop outdoor air intakes to prevent birds from polluting shafts below.

c. Air flow monitoring devices are located in the ducts on the outdoor air side of the two major air handling systems to monitor and regulate the amount of outdoor and re-circulated air needed to provide the minimum ventilation rates.

d. The HVAC system will include a high efficiency air filtration system with pre-filters and final filters at 30% and 85% efficiency respectively. (The 85% efficient filters remove about 65% of 0.5µm particles of the finer airborne dust.) [3]

e. Exposed fiberglass (porous insulation)within the HVAC system has been encapsulated to eliminate amplification sites for fungal and bacterial microorganisms [3] with only minimum impact on sound attenuation, as follows:

1) Acoustic panels in the air handling units are encapsulated with a thin mylar coat with inner perforated metal liner. Stainless steel will be used for the liner where outdoor air moisture is present

2) Acoustical lining in the ductwork will have inner perforated metal liners.

3) All acoustical and insulation material in the variable air volume (VAV) terminal units will be foil faced.

f. The HVAC system is designed to deliver an average minimum ventilation air rate of 25 CFM of outdoor air per occupant.

g. The HVAC system has an electronic direct digital control Building Automation System with an outside air economizer. The digital control will provide the building operator with a quick response to comfort problems. The outdoor air economizer system allows larger quantities of outdoor air when the outdoor temperature is between 55°F to 72°F.

h. The roof air exhausts are located along the edge of the linear and circular atria, more than 12.2 m. (40ft.) away from the outdoor air intakes. [3]

i. Copy rooms were designed with their own dedicated air exhaust system to isolate the photocopy machines. These rooms have resilient floors in lieu of carpets for easy cleaning.

j. A commissioning procedure for the HVAC system, as recommended by the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) has been documented in the Project Manual and include financial penalties to encourage the Contractor to perform the commissioning process.[4] This will include a design phase documentation of the HVAC design criteria and system description, and during the Construction Phase, accurate documentation of the HVAC operating procedures, training of the HVAC maintenance staff, and fine tuning of the HVAC system for up to three months after the building has been occupied.

k. The HVAC system could be operated at 100% outside air[5] to purge the building of material VOC's for three months prior to the move-in (during the furniture installation). "Bake-outs" are not recommended.

l. We have recommended that the library develop and implement a scheduled building maintenance plan. They are currently developing this plan, and the budget requirements for its staffing requirements.

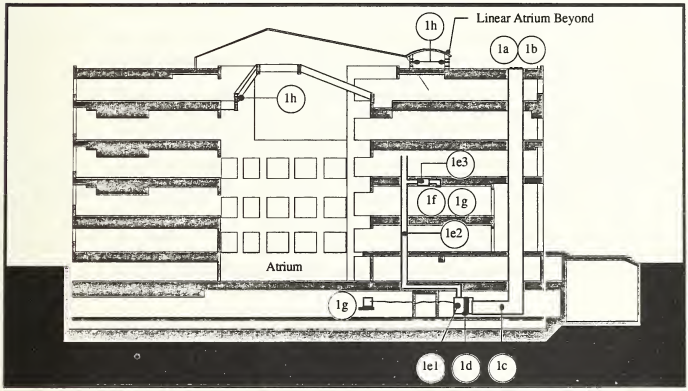

Diagram 1. section Through Library - HVAC System Strategies

2. MATERIALS/PRODUCTS/FURNITURE STRATEGIES

After cleaning up the HVAC system, the next most important task is to ensure that the materials products and furniture that are installed in the library are not going to off-gas toxic compounds into the air. The following is a list of the strategies used to reduce the off-gassing from some of the major materials, product and furniture: –

a. Particle board: The project specifications prohibit the use of particle board on this project. This will reduce formaldehyde emissions into the air.[1,6]

b. Carpet

1) Stone floors (granite and limestone) are specified for the entry level floors at the main entries, atrium, and auditorium lobby. Patrons will enter over stainless steel floor mats and walk about 30.5 m. (100 ft.) prior to reaching the carpeted areas. This allows dirt and particulate matter to be removed from their shoes before being deposited onto the carpets

2) Most of the carpet material available in the United States today (diagram 2A) is bound together with a Styrene Butadiene Rubber (SBR) latex that emits 4 phenylcyclohexine[7] (4-PC). The Architects worked with a mill to develop a carpet that does not generate detectable levels of 4-PC, and specified a custom carpet – a two-shot, three frame Wilton (Diagram 2B). The specifications exclude the use of SBR latex, require the contractor to condition (air out) the carpets prior to installation, and to perform a carpet chamber text at the end of the first 24 hours (to detect any 4-PC emissions).

3) The Architects recommended that the Library clean the carpets regularly with High Efficiency Particulate Arrestor (HEPA) vacuums.

c. Adhesives: One "low emitting" solvent-free adhesive was specified for the project. Although many manufacturers claim to produce this product, only one company provided sufficient information for the Architect's evaluation. This information was supported by a previous study[8], which indicated relatively low emissions from the carpet/adhesive installation, where we understand, similar adhesive products were specified.

d. Paints: Only "solvent-free" paints have been specified for this project. Excluded are high VOC emitting paints, paints that contain preservative and anti-freeze, and those which cannot be field applied as a "touchup to pre-finished metal work in California, because of their flammability and volatility. The paint specification was developed to accommodate predicted changes in the pain industry, which itself is modifying formulations to reduce missions. When the pain is needed (late 1994 to mid 1995), we will review the paint contractor's submittal and will accept only low VOC emitting paints.

e. Furniture: The furniture will be constructed without the use of particle board. Manufacturers will be instructed to use low-VOC emitting adhesives and finishes, to "air out" the furniture prior to delivery, and to use a solvent free cleaning agent for cleaning the system components prior to delivery.[4]

f. Books: We have recommended that the library clean their books prior to moving them into the new library

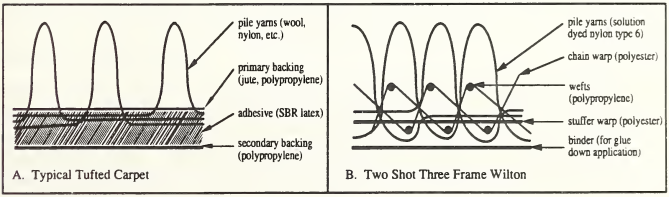

Diagram 2. Carpet

3. Cost

The IAQ design fee accounts for approximately 0.60% of the Architectural/Engineering fees, and the construction cost for the IAQ strategies is estimated to account for 1.1% of the Construction Budget (Figure 1).

	Estimated Construction Cost for IAQ Strategies*	IAQ Strategies Cost as a percentage of Construction Budget
HVAC Systems Strategies		
1. a. Roof Fresh air intakes	**	0.00%
b. Stainless steel bird guard	$10,000	0.01%
c. Air flow measuring devices	$8,750	0.01%
d. High efficiency air filtration	$15,000	0.02%
e. Encase fiberglass insulation		
1) Air handling units	$7,500	0.01%
2) Ductwork	$35,000	0.04%
3) VAV terminal units	$40,000	0.05%
f. High ventilation rate	$168,750	0.19%
g. Building automation system	**	0.00%
h. Roof air exhausts	**	0.00%
i. Photocopy rooms air exhaust	$10,000	0.01%
j. HVAC commissioning	$50,000	0.06%
k. Building ventilation	***	0.00%
l. Maintenance	***	0.00%
Materials and Products Strategies		
2. a. Plywood in lieu of particle board	$50,000	0.06%
b. Carpet		0.00%
1) Stone floor at entry	**	0.00%
2) Custom carpet	$500,000	0.57%
3) Carpet maintenance	***	0.00%
c. Sole source adhesive	$60,000	0.07%
d. Paints	**	0.00%
e. furniture	***	0.00%
TOTAL	$955,000	1.10%

* Cost Consultant's estimate.
** No additional cost as items were incorporated prior to the IAQ.
*** These costs are excluded from the construction budget.

Figure 1. Estimated Construction Costs for Indoor Air Quality Strategies

4. Construction Phase Strategies

The Architects introduced the idea of a healthy library to the contractor at the Pre-construction Conference and will reinforce the issue at the numerous Pre-Installation meetings with their sub-contractors. The contractors will be required to provide emissions tests with product substitutions and submittals, which will be carefully reviewed prior to incorporation of these products into the building.

SUMMARY AND CONCLUSIONS

Healthy library design requires commitment from the project sponsors, including the Library (management and staff), the Architects and their Consultants and the Contractors. Leadership is needed to develop a team, to educate, to facilitate discussions, and to moderate the final results. Meetings with the tenants and public groups are needed to affirm the Architect's proactive stand on the IAQ issues, and in demistifying these issues. (The library staff were less concerned about non-operable windows when it was explained that outside air in excess of the minimum would be circulated for at least 90% of the year.)

IAQ strategies for general building types are available and well documented in the literature. They need some modification and adaptation for use in libraries, but are generally applicable. The important issue here is to assemble the appropriate strategies for each library project and to implement them.

Implementation becomes easier when it is understood that IAQ design is cost effective, especially when looked at in terms of long term costs. Initial design and construction costs may be marginally higher, however, when viewed in terms of human health and potential litigation, the impact on the project budget will prove to be cost effective. It should be noted here that the design and construction costs will be further reduced as IAQ strategies and low emitting VOC ("Healthy") materials become more available in the "mainstream" marketplace. They will become the new industry standard.

This project provided the Architects with an opportunity to design a healthy public library for the City of San Francisco. The strategies, techniques and modified materials will be of interest to librarians who are planning new or renovated libraries and to those who are responsible for maintaining and operating their present facilities.

ACKNOWLEDGEMENTS

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2. The Architects for the New San Francisco Main Library are: Pei Cobb Freed & Partners & Simon Martin-Vegue Winkelstein Moris Associated Architects

3. Flack & Kurtz Consulting Engineers) (Mechanical Electrical and Plumbing Engineers) Reginald Monteyne & Ron Arthur; Paoletti Associates, (Acoustical Consultants) Red Wetherill; Oppenheim Lewis, Inc. (Cost Consultants) Scott Lewis; John Raeber, AIA, CSI (Specifications Writer); Hal Levin & Associates, (IAQ Consultant) Hal Levin

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